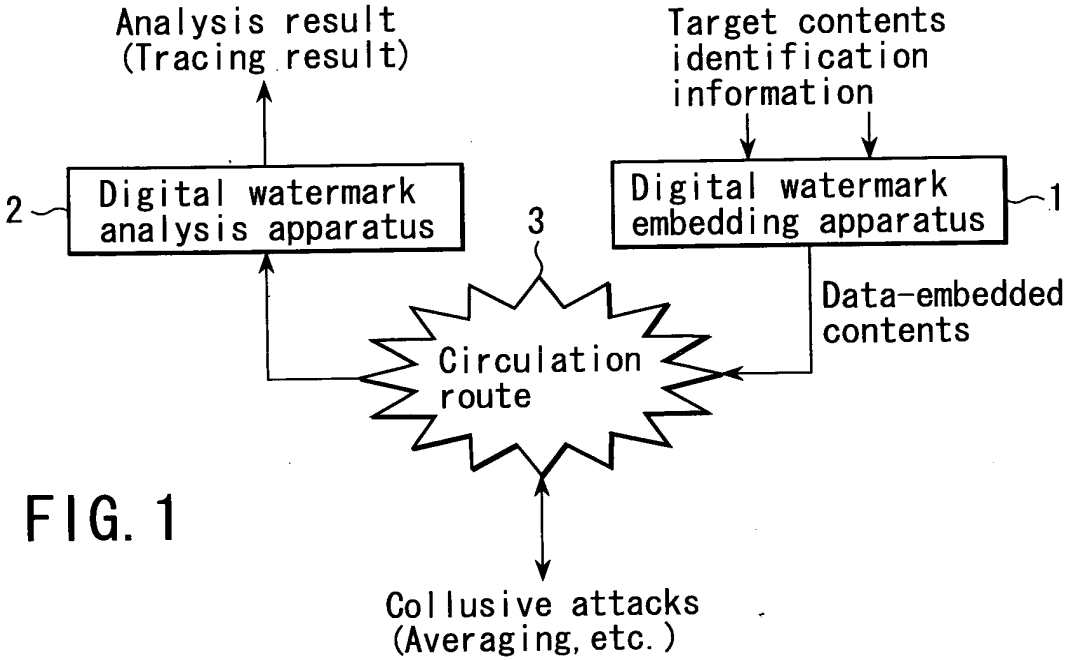
Analysis result
(Tracing result)
Target contents
identification
information
Digital watermark
analysis apparatus
2
3
Digital watermark
embedding apparatus
1
Data-embedded
contents
Circulation
route
Collusive attacks
(Averaging, etc.)

FIG. 1

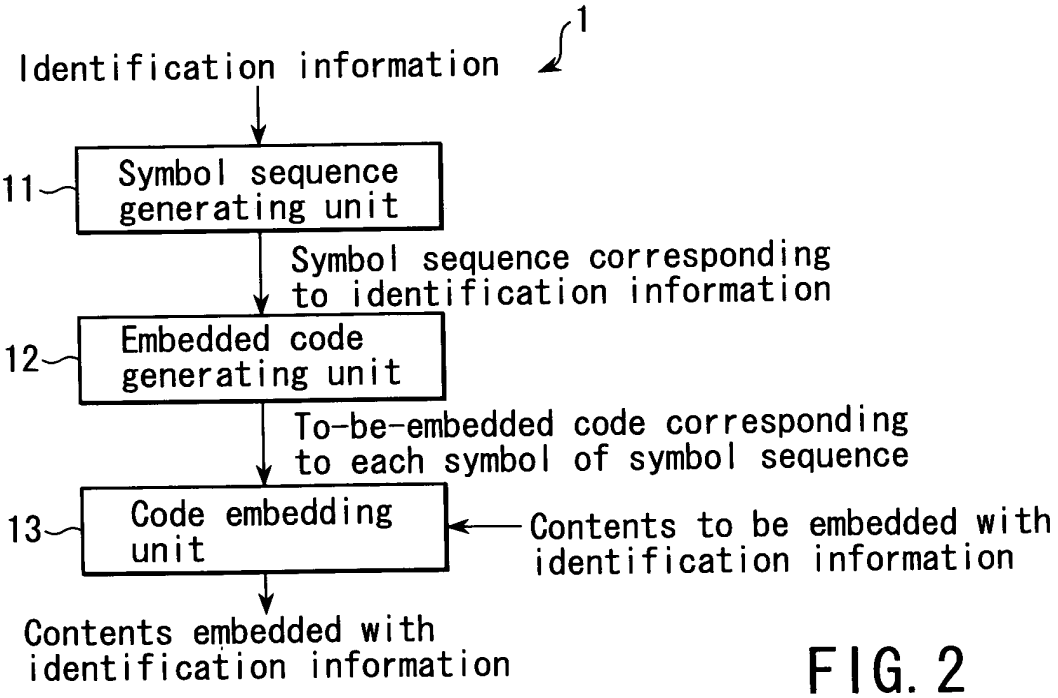
1
Identification information
11
Symbol sequence
generating unit
Symbol sequence corresponding
to identification information
12
Embedded code
generating unit
To-be-embedded code corresponding
to each symbol of symbol sequence
13
Code embedding
unit
Contents to be embedded with
identification information
Contents embedded with
identification information

FIG. 2

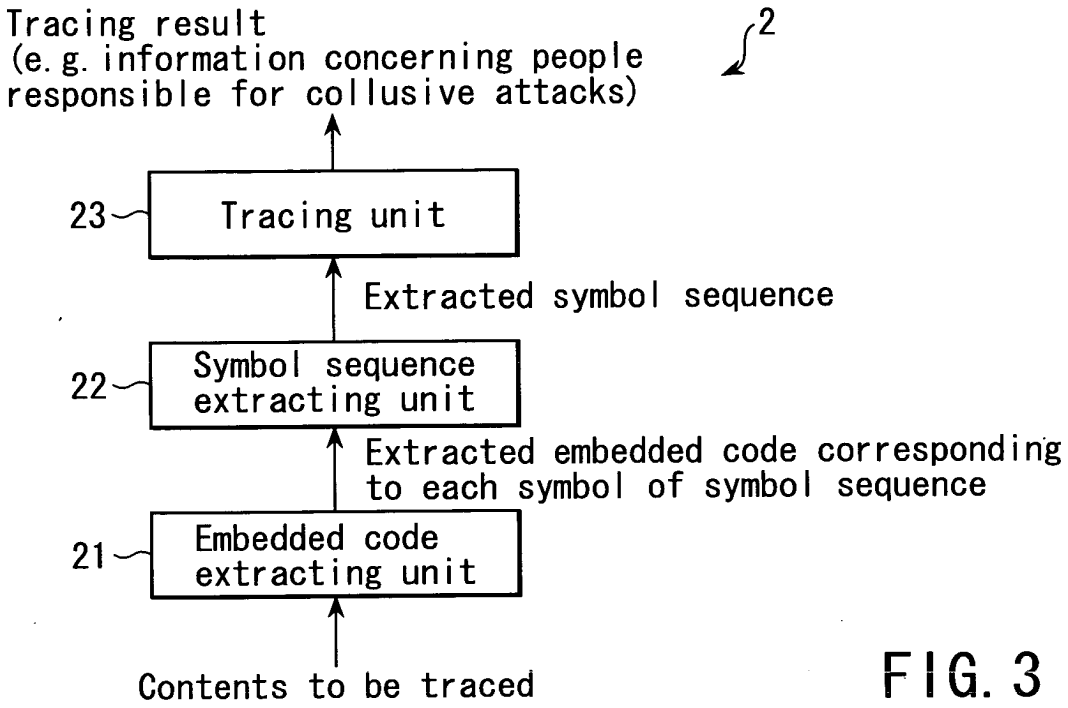
Tracing result
(e.g. information concerning people responsible for collusive attacks)
2
23
Tracing unit
Extracted symbol sequence
22
Symbol sequence extracting unit
Extracted embedded code corresponding to each symbol of symbol sequence
21
Embedded code extracting unit
Contents to be traced

FIG. 3

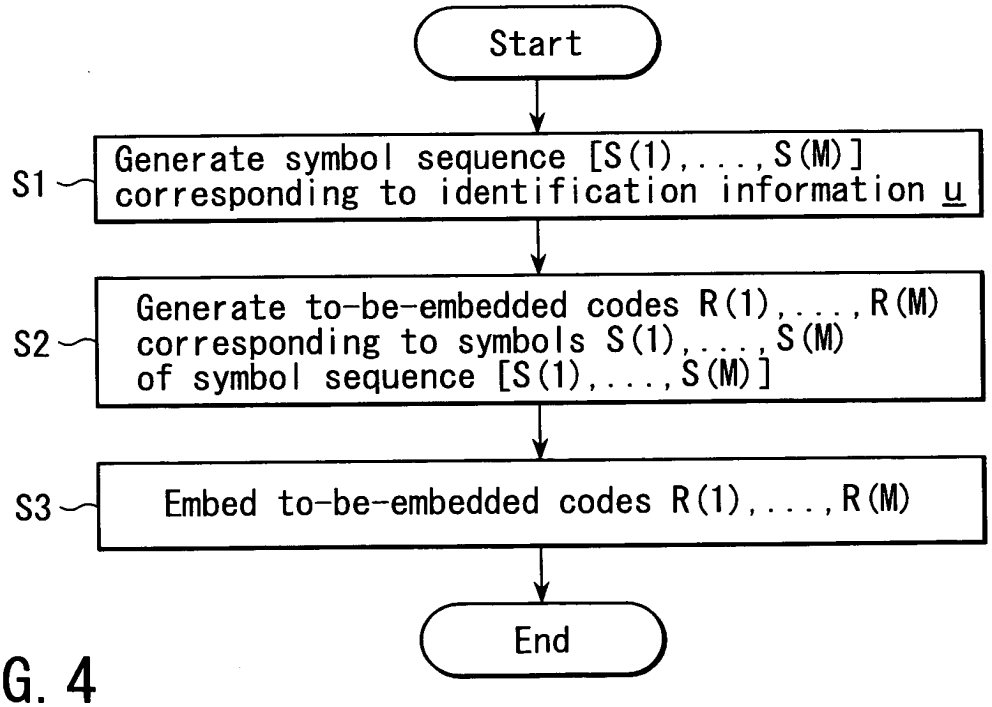
Start
S1
Generate symbol sequence [S(1),...,S(M)] corresponding to identification information u
S2
Generate to-be-embedded codes R(1),...,R(M) corresponding to symbols S(1),...,S(M) of symbol sequence [S(1),...,S(M)]
S3
Embed to-be-embedded codes R(1),...,R(M)
End

FIG. 4

ID	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S(1)	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
S(2)	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4
S(3)	0	1	2	3	4	5	6	0	1	2	3	4	5	6	0

FIG. 5A

ID	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S(1)	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
S(2)	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
S(3)	a	b	c	d	e	f	g	a	b	c	d	e	f	g	a

FIG. 5B

User ID	Symbol sequence corresponding to user ID	
0	{0, 0, 0}	{a, a, a}
1	{1, 1, 1}	{b, b, b}
2	{2, 2, 2}	{c, c, c}
3	{0, 3, 3}	{a, d, d}
4	{1, 4, 4}	{b, e, e}
5	{2, 0, 5}	{c, a, f}
6	{0, 1, 6}	{a, b, g}
7	{1, 2, 0}	{b, c, a}
8	{2, 3, 1}	{c, d, b}
9	{0, 4, 2}	{a, e, c}
10	{1, 0, 3}	{b, a, d}
11	{2, 1, 4}	{c, b, e}
12	{0, 2, 5}	{a, c, f}
13	{1, 3, 6}	{b, d, g}
14	{2, 4, 0}	{c, e, a}

FIG. 6

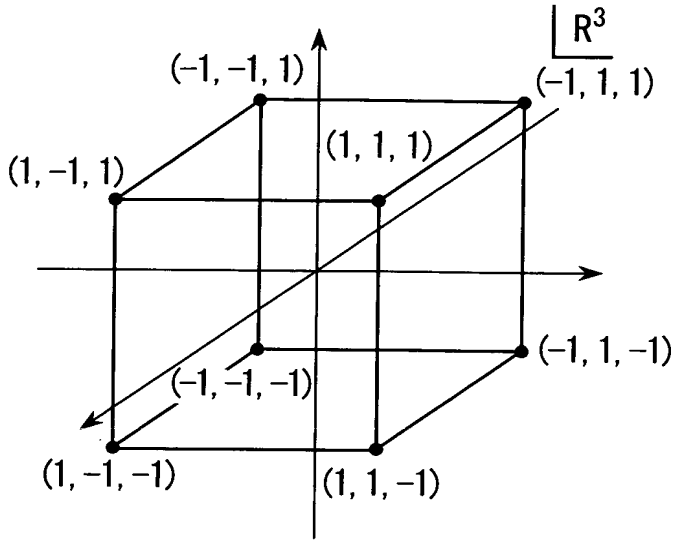

FIG. 7

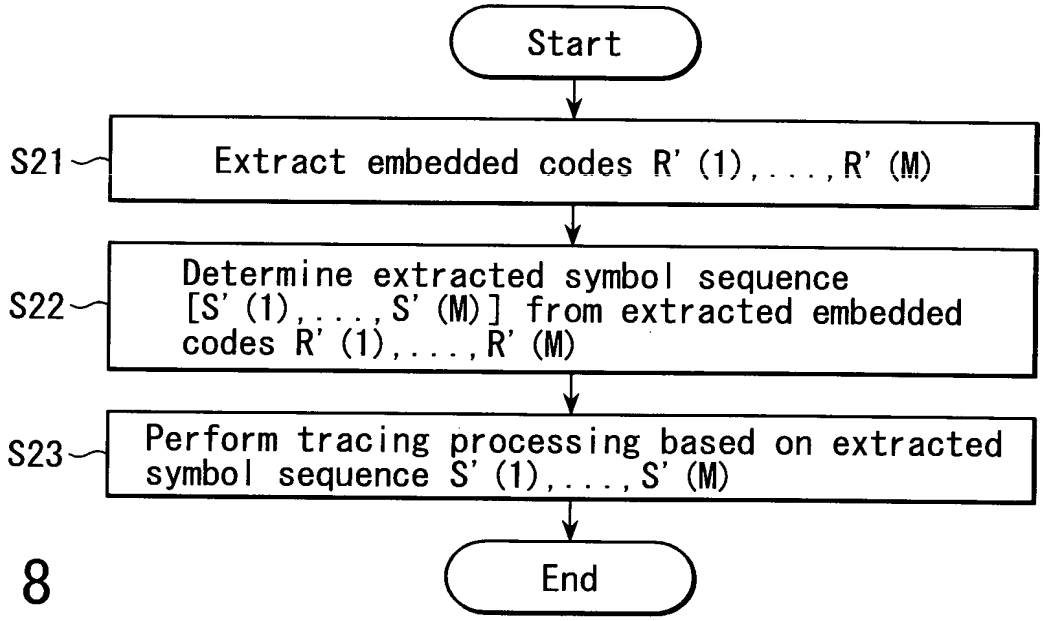

FIG. 8

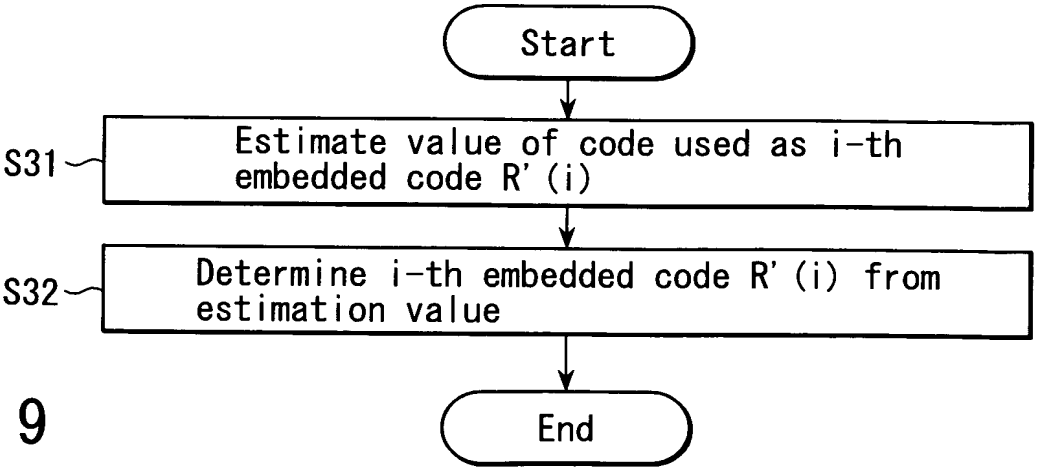

FIG. 9

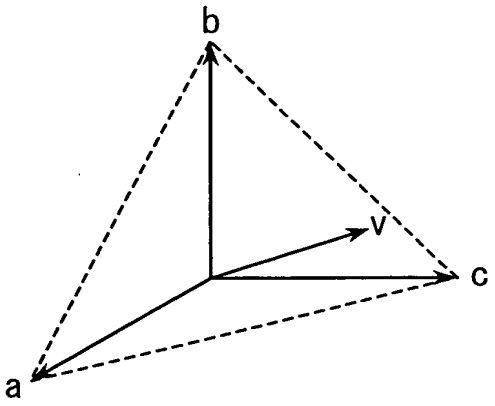

FIG. 10

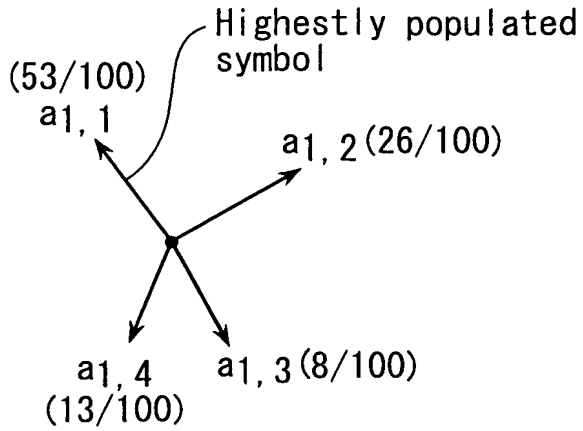

FIG. 11A

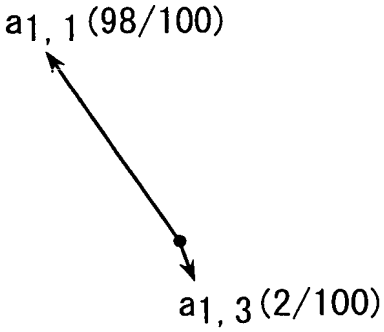

FIG. 11B

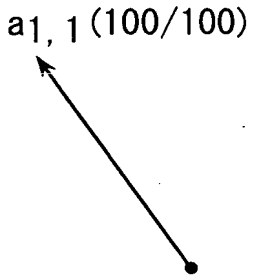

FIG. 11C

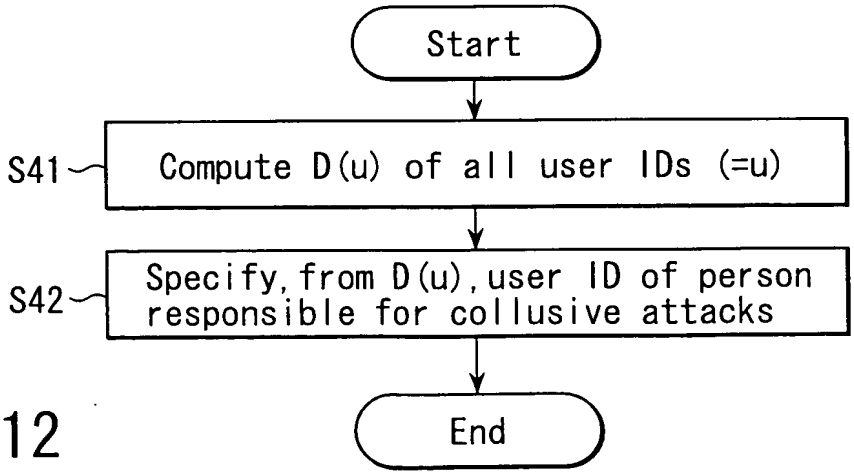

FIG. 12

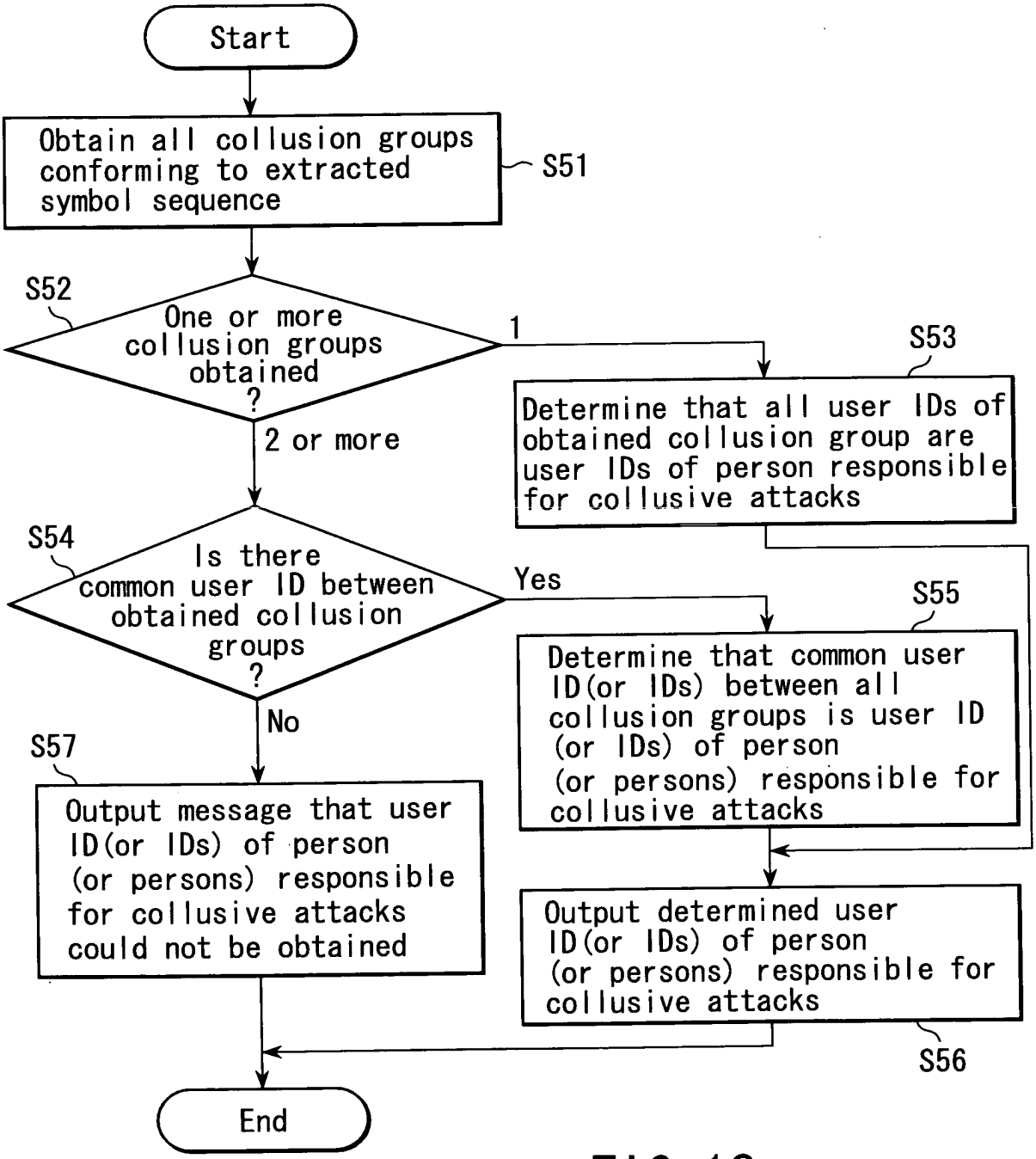
Start
Obtain all collusion groups conforming to extracted symbol sequence
S51
S52
One or more collusion groups obtained ?
1
2 or more
S53
Determine that all user IDs of obtained collusion group are user IDs of person responsible for collusive attacks
S54
Is there common user ID between obtained collusion groups ?
Yes
No
S55
Determine that common user ID(or IDs) between all collusion groups is user ID (or IDs) of person (or persons) responsible for collusive attacks
S57
Output message that user ID(or IDs) of person (or persons) responsible for collusive attacks could not be obtained
Output determined user ID(or IDs) of person (or persons) responsible for collusive attacks
S56
End

FIG. 13